Fast generation algorithm of high-definition computer generated hologram with viewing zone splitting and localized polygon calculation

Sungjae Park, Jonghyun Lee and Hwi Kim
Department of Electronics and Information Engineering, College of Science and Technology, Korea University, 2511 Sejong-ro, Sejong 30019, Korea
Tel.:82-44-860-1428, E-mail: hwikim@korea.ac.kr

Wide-viewing angle high-definition(HD) computer generated hologram(CGH) has been actively developed and studied by many researchers because it can display realistic and high quality 3D display [1-2]. HD CGH has a large scale that requires huge computational time and great memory, so reducing amount of computation area and fast calculating are the most important techniques. In this paper, we proposed a method to calculate the light wave of localized polygon mesh by dividing the viewing zone for the large scale of HD CGH. This method not only improves the calculation speed but also uses less memory.

Fig. 1 shows the conceptual diagram and visualization result for the fast calculation of wide-viewing angle HD CGH using viewing zone segmentation and localized polygon calculation. The first step is to divide and calculate in the viewing zone. This shortens the calculation area and computational time of the HD CGH. The second step is to local calculate the angular spectrum of the polygon mesh for the segment area [3]. This method calculates only some areas depending on the polygon size, unlike the traditional method of calculating the entire area for calculating one polygon. Finally, the locally computed small fields are stamped into their original large field, respectively. This procedure improves memory efficiency and enables fast HD CGH calculations.

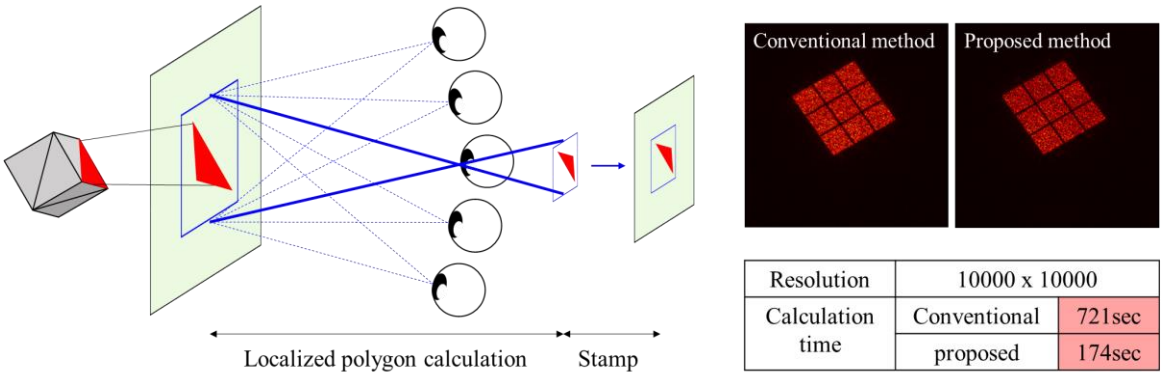

Fig. 1. Conceptual diagram and visualization result viewing zone splitting and localized polygon calculation

We believe that the proposed method can efficiently calculate wide-viewing angle HD CGH and is useful for many applications. Our future work is to build a system that calculates 160K by 160K full-color HD CGH and make it through the actual process.

Acknowledgment

This work was supported by the Industrial Strategic technology development program (10052641, Development of the commercialization platform technology for diffractive optical element based on 3D surface nanostructure for full-color implementation) funded by the Ministry of Trade, industry & Energy (MI, Korea).

References

1. Y. Tsuchiyama, K. Matsushima, S. Nakahara, and Y. Sakamoto, "Full-Color High-Definition CGH Using Color Filter and Filter Design Based on Simulation," in Imaging and Applied Optics 2016, OSA Technical Digest (online) (Optical Society of America, 2016), paper DW5I.4.
2. K. Matsushima and S. Nakahara, "Extremely high-definition fullparallax computer-generated hologram created by the polygon-based method," Applied optics 48, H54-H63 (2009).
3. J. Cho, J. Hahn, and H. Kim, "Fast reconfiguration algorithm of computer generated holograms for adaptive view direction change in holographic three-dimensional display," Optics Express, Vol. 20, No. 27, pp. 28282-28291, (2012).